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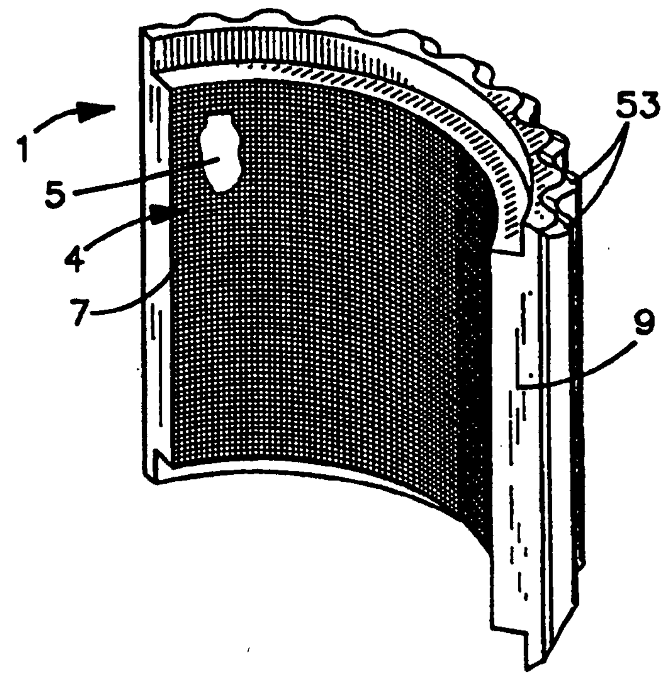
(54) **SURFACE DE PREHENSION A PARTICULES GRANULEUSES**

(54) **GRANULAR PARTICLE GRIPPING SURFACE**



(57) L'invention concerne un appareil amélioré destiné à la préhension d'éléments tubulaires (10) de champs pétrolifères. Ledit appareil comporte un élément superficiel de préhension (53) qui comprend un élément superficiel de support (5) conçu pour venir en contact avec un élément tubulaire (10) de champ pétrolifère, cet élément superficiel de support (5) pouvant être fixé à l'appareil destiné à la préhension d'éléments tubulaires (10) de champs pétrolifères. Ledit appareil comporte en outre un revêtement de particules granuleuses (7) formées sur ledit élément superficiel de support (5). Dans un mode de réalisation préféré, la surface de préhension (4) comprend un carbure de métal réfractaire sélectionné dans le groupe constitué des carbures de silicium, de tungstène, de molybdène, de chrome, de tantale, de niobium, de vanadium, de titane, de zirconium, et de bore.

(57) This invention provides an improved apparatus for gripping oil field tubular members (10). The apparatus has a gripping surface (53) which comprises a backing surface (5) adapted to contact an oil field tubular member (10) where the backing surface (5) is attachable to the apparatus for gripping oil field tubular members (10). The apparatus further has a granulated particle coating (7) formed on this baking surface (5). In a preferred embodiment, the gripping surface (4) will include a refractory metal carbide selected from the group consisting of the carbides of silicon, tungsten, molybdenum, chromium, tantalum, niobium, vanadium, titanium, zirconium, and boron.

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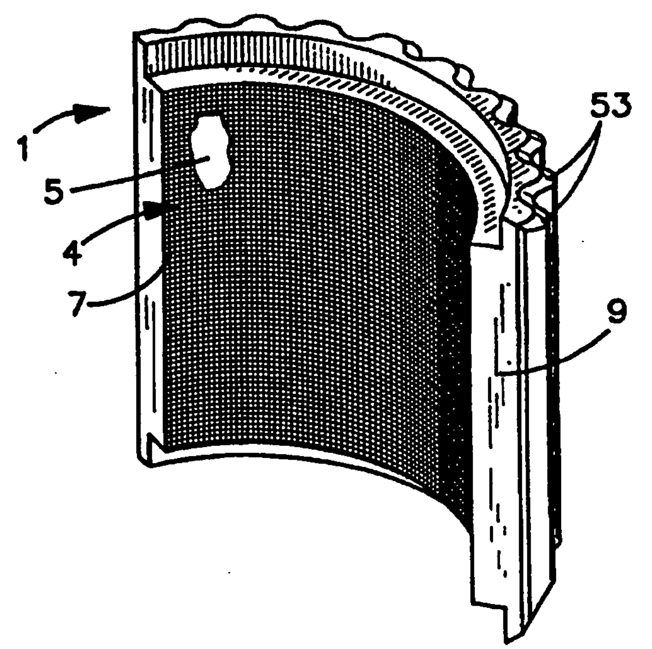
(54) Title: GRANULAR PARTICLE GRIPPING SURFACE

(57) Abstract

This invention provides an improved apparatus for gripping oil field tubular members (10). The apparatus has a gripping surface (53) which comprises a backing surface (5) adapted to contact an oil field tubular member (10) where the backing surface (5) is attachable to the apparatus for gripping oil field tubular members (10). The apparatus further has a granulated particle coating (7) formed on this baking surface (5). In a preferred embodiment, the gripping surface (4) will include a refractory metal carbide selected from the group consisting of the carbides of silicon, tungsten, molybdenum, chromium, tantalum, niobium, vanadium, titanium, zirconium, and boron.



GRANULAR PARTICLE GRIPPING SURFACE

TECHNICAL FIELD

This invention relates to devices used in the oil and gas well drilling industry to grip tubular members, such as oil well piping and casing, in order to rotate the tubular member or to hold the tubular member fixed against rotation. In particular, this invention relates to gripping devices that can securely grip an oil field tubular member while not leaving damaging gouges or marks on the surface of the tubular member.

BACKGROUND ART

There presently exist numerous devices that may be used to grip tubular members while torque is being applied to the tubular member. Such devices include by way of illustration "power tongs," "backups," and "chrome tools" and various other devices for gripping tubular members. Examples of power tongs are disclosed in U.S. Patent Nos. 4,649,777 and 5,291,808 to David Buck. Typically power tongs will have a set of jaws which are the actual components of the power tongs which grip the tubular member. One example of these jaws is set forth in U.S. Patent No. 4,576,067 to David Buck. The jaws disclosed in U.S. Patent No. 4,576,067 include a die member which is the sub-component of the jaw that actually contacts the tubular member. In U.S. Patent No. 4,576,067, the face of the die that contacts the tubular member has ridges or teeth cut therein. When the jaws close upon the tubular member, these teeth firmly "bite" into the tubular member and prevent slippage between the tubular member and jaws when large torque loads are applied to the power tongs or the tubular member.

While the above described method for gripping pipe has been successful in many applications, there are certain disadvantages. One disadvantage is that after gripping tubular members, the teeth from the die will leave indentations or gouges in the surface of the tubular member. These "bite marks" left by the teeth may effect the structural integrity of the tubular

member by causing a weak point in the metal which may render the tubular member unsuitable for further use.

A second disadvantage is encountered when using the dies with corrosion resistant alloy (CRA) tubular members. Stainless Steel is an example of a typical CRA used in the oil and gas drilling industry. Because the above described die teeth are normally constructed of standard carbon steel, the bite mark made by the die teeth tend to introduce iron onto the surface of the CRA tubular. The iron in the bite mark then tends to produce corrosion and rust, thereby further damaging the CRA tubular.

A further problem is encounter in that many CRA materials such as stainless steel are work hardened materials. This means that the malleability of the material decreases after the material is mechanically stressed. In the case of stainless steel tubulars, the bite marks or indentations caused by the prior art die teeth produce localized "cold working". The points at which the teeth marks have been made are then less malleable than the other sections of the tubular and therefore may create inherent weak points in the tubular's structural integrity.

As an alternative to using dies with teeth on CRA tubulars, the industry has employed dies which have smooth aluminum surfaces engaging the tubular. However, because aluminum is a comparatively soft metal, dies having aluminum surfaces must employ significantly greater clamping forces than dies with steel teeth. This greater clamping force in turn increases the risk that the clamping forces themselves will cause damage to the tubular. Furthermore, even with high clamping forces, the aluminum surfaces often do not have a sufficiently high coefficient of friction to prevent slippage between the dies and the tubular at high torque loads.

To overcome the problem of slippage between the aluminum surfaced dies and a CRA tubular, the industry has developed a method of using a silicon carbide coated fabric or screen in combination with the aluminum surfaced dies. This method consists of placing the silicon

carbide screen between the tubular and the dies before the dies close upon the tubular. The dies are then closed on the tubular with the silicon carbide screen positioned in between. The silicon carbide screen thereby allows a substantially higher coefficient of friction to be developed between the dies and the tubular. However, this method also has serious disadvantages. First, the silicon carbide screen must be re-position between the tubular and die surface each time the dies grip and then release a tubular. Thus for example, when a drilling crew is making up or breaking down a long string of drill pipe, the silicon carbide screen must be placed in position for each successive section of pipe being made up or broken down. This repeated operation can be extremely inefficient and costly in terms of lost time. Secondly, this process requires a member of the drilling crew to repeatedly place his hands in a position where they could possible be crushed or amputated. Thirdly, while providing greater resistance to torque than a smooth surfaced aluminum die, there may nevertheless be situations where such high torque forces are being applied to the tubular that the silicon carbide screen method does not prevent slippage between the die and the tubular.

DISCLOSURE OF THE INVENTION

Therefore it is an object of this invention to provide, in an apparatus for gripping tubular members, a gripping surface which does not leave bite marks, yet has a higher coefficient of friction than found in the present state of the art.

It is another object of this invention to provide a gripping surface that has greater longevity than hereto known in the art.

It is a further object of this invention to provide a high coefficient of friction gripping surface that is safer to employ than hereto known in the art.

Therefore the present invention provides an improved apparatus for gripping oil field tubular members. The apparatus has a gripping surface which comprises a backing surface

adapted to contact an oil field tubular member where the backing surface is attachable to the apparatus for gripping oil field tubular members. The apparatus further has a granulated particle coating formed on this backing surface. In a preferred embodiment, the gripping surface will include a refractory metal carbide selected from the group consisting of the carbides of silicon, tungsten, molybdenum, chromium, tantalum, niobium, vanadium, titanium, zirconium, and boron.

DESCRIPTION OF THE DRAWINGS

Figure 1 is a cut-away top view of a conventional power tong illustrating the manner in which the tubular gripping jaws of the power tongs grasp the tubular member.

Figure 2a is a perspective view of a conventional jaw member showing a die insert with conventional diamond tooth knurl pattern gripping surface.

Figure 2b is a top view of a conventional jaw member showing the die insert separated from the jaw member.

Figure 3 is a perspective view of a die having the granular particle gripping surface of the present invention.

Figure 4 is a cross-sectional view of an alternate embodiment of the present invention which comprises a set of bridge plug slips having a granular particle gripping surface.

Figure 5 is a perspective view of one slip according to the present invention.

Figure 6 is a cross-sectional view the bridge plug of Figure 4 illustrating the bridge plug in an activated position.

BEST MODE FOR CARRYING OUT THE INVENTION

The present invention will be capable of use in various apparatuses for gripping oil field tubular members. The above mention of power tongs, backup power tongs and chrome tools is intended to be illustrative only. It is believe the present invention will have application in

many other types of devices used for gripping oil field tubular members. As discussed herein, oil field tubular member is intended to describe all types of piping, casing, or other tubular members use in the oil and gas industry. One example of such an apparatus is the power tongs disclosed in U.S. Patent No. 5,291,808. Figure 1 is a top view of the internal parts of this power tong illustrating the location of jaws **50** which close upon and grip oil field tubular member **10**. An example of jaw **50** is shown in more detail in Figures 2a and 2b. As explained in detail in U.S. Patent No. 4,576,067 which is incorporated by reference herein, jaw **50** will include a pin aperture **52** which allows jaw **50** will be connected to the power tong or other apparatus for gripping tubulars. As best seen in Figure 2b, jaw **50** further has a generally concave shaped removably insertable die **51**. Die **51** is positioned in jaw **50** by the interlocking of spline **53** and groove **55** and is held in place by retaining screw **54**. Concave die **51** is adapted to engage oil field tubular member **10**. Die **51** also has a conventional gripping surface **56** formed from a diamond shaped series of gripping teeth. This prior art gripping surface **56** has several of the disadvantages discussed above.

Figure 3 is a perspective view of a die having the novel gripping surface of the present invention. In the embodiment shown, the gripping surface is formed on a die having splines **53** similar to that shown in Figures 2a and 2b. Die **1** in Figure 3 generally includes a body portion **9**, splines **53** formed on the rear of body **9** and a face section **4** making up the front of body **9**. The gripping surface of the present invention is formed on the face section **4** of the body **9** by a coating **7** which is shown as the shaded surface portion of face section **4**. The surface of face section **4** immediately below coating **7** forms the backing surface **5** to which coating **7** adheres. Backing surface **5** is shown in Figure 3, where a portion of coating **7** has been removed from face section **4**. Those skilled in the art will recognize that dies are manufactured in standard

dimensions and it is sometimes desirable to maintain these standard dimensions despite the additional thickness coating 7 will add to the total dimension of the die 1. Therefore, in some applications it will be necessary to reduce the thickness of face section 4 by an amount equal to the thickness of the coating 7 which is applied to die 1. This insures that a die 1 of the present invention will be manufactured to the standard die dimensions used in the industry.

In general terms, coating 7 comprises a granulated particle substance which has been firmly attached to backing surface 5 to form the granular particle coating 7. The granular particle coating 7 produces a high friction gripping surface on the face 4 of die 1. In use, the dies 1 are inserted into jaw members which in turn are the component of power tongs that grip the tubular member as described above. When the jaws of the power tongs close on a tubular member as suggested by Figure 1, the gripping surface of dies 1 is pressed against the tubular member. Over the entire surface of the die face, the granular particles are microscopically penetrating the outer most surface of the tubular member. It will be understood that because of the small size of the granular particles as explained below, it is only the outer most surface of the tubular that is being penetrated and this does not result in the comparatively deep and damaging bite marks produced by the prior art die teeth described above. However, because this microscopic penetration is occurring over the entire surface of the die, the gripping strength is substantial even without the deep penetration of the prior art die teeth.

One embodiment of the granular particle coating and the process used to apply it to the backing surface of the die is disclosed in U.S. Patent No. 3,094,128 to Dawson, which is incorporated by reference herein. However, other granular particles and methods of application are considered to be within the scope of this invention. The granular particles will be graded to include a wide range of sizes such as from approximately 100 microns to 420 microns in diameter. One embodiment of the invention will use granular particles in the range of

approximately 300 to 400 microns. Of course these size ranges are only approximate and sizes of particles greater than 420 microns and smaller than 100 microns may be used in particular applications.

The material from which the granular particles are formed can also vary widely. In one embodiment, carbides of refractory metals were found to be suitable. Such refractory metal carbides include carbides selected from the group consisting of the carbides of silicon, tungsten, molybdenum, chromium, tantalum, niobium, vanadium, titanium, zirconium, and boron. It is envisioned that in place of carbides, borides, nitrides, silicides, and the like may be used singly or in mixtures. However, other refractory metals and metalloids may form a suitable granular particle material. There are generally two requirements for a granular particle material to be suitable for the gripping surface of the present invention. First the material must be capable of being firmly adhered to the backing surface of the die such that the large torque the die faces resist will not dislodge the particles from the backing surface. Second, the material must be sufficiently hard that the granules of the material will penetrate the outermost surface of a tubular member rather than simply being crushed between the backing surface and the tubular member.

As mentioned, it is necessary to adhere the granular particle material to the backing surface firmly enough that the high torque forces do not dislodged the particles from the backing surface. A preferred embodiment of the invention accomplishes this by utilizing a metal matrix or brazing alloy to fuse the granular particle material to the backing surface. The metal matrix preferably has a melting or fusing point lower than the melting or fusing point of the granular particle material or the backing surface. Typical brazing alloys could include cobalt-based and nickel-based alloys, notably those containing significant proportions of chromium. Alternatively, copper, copper oxide or a copper alloy such as bronze can be used. The brazing alloy may also

contain boron, silicon, and phosphorus. Suitable brazing materials are available commercially and can be used in their commercially available forms.

Several preferred processes for applying the granular particle coating to the die face are disclosed in U.S. Patent Nos. 3,024,126 and 4,643,740, which is also incorporated by reference herein. Generally the metal matrix or brazing alloy and the refractory particles are applied to the backing surface of the die and the die is heated to a tempature sufficient to cause the metal matrix to reach a liquid or semi-solid state. When the metal matrix cools from the liquid or semi-solid state, the granular particles will be firmly bonded or fused to the backing surface. In practical application, the process begins by cleaning the die backing surface to remove grease or scale from the backing surface. Next a temporary adhesive or binder material is applied to the backing surface to which the metal matrix and the refractory particles will adhere until heating of the die takes place. The temporary adhesive may be a volatile liquid vehicle, such as water, alcohol, or mixtures thereof, or the like which can be volitized and dried readily. This allows the temporary adhesive to be applied by a spay on process, roller type applicators, or by any other conventional manner. "Shellac" as disclosed in U.S. Patent No. 3,024,128 is one such temporary adhesive. After application of the temporary adhesive, the metal matrix and refractory particles will applied be to the backing surface. The metal matrix and refractory particles are will typically be in a powder form and generally sprinkled in a thin layer onto the backing surface. The sprinkling process can be carried out by any number of machines such as the electro-magnetically vibrated feeder as disclosed in column 5 of U.S. Patent No. 3,024,128. Generally, some conventional method is used to insure any excess powder is not retained on the backing surface. For example, the backing surface may be positioned at an angle during the sprinkling process such that only the thin layer of powder actually contacting the adhesive remains on the backing surface and any excess powder falls from the backing surface. In this

manner, the thickness of the final granular coating may be no greater than the diameter of the largest granular particles.

Prior to the die being heated, a flux agent is also added to the backing surface. The flux agent tends to give fluidity to the heated materials, tends to lower the melting point of the high melting oxides, and provides protection against unwanted oxidation. The flux covers or envelops the backing surface to protect it from oxidation by the atmosphere while heating. It also dissolves any oxides formed on the metallic surfaces, lowers the surface tension of the molten or plasticize matrix to allow it to flow or spread sufficiently to coat all adjacent parts or particles to form a fusion bond between the particles and the backing surface. Those skilled in the art will recognize a wide variety of commercially available flux agents may be used. In a preferred embodiment, fluoride based fluxes and borax/boric acid mixtures were found suitable. The flux may be applied to the backing surface after application of the refractory particle/metallic matrix powder or it may be mixed with the powder before its application to the backing surface.

After the refractory particle/metallic matrix powder and the flux have been applied to the backing surface, the die will be subject to a heating process. There are numerous heating processes that may be used fuse the refractory particles to the backing surface. For example, U.S. Patent No. 3,024,128 discloses heat could be applied by a welding torch for small production runs. For larger production, gas fired or electric furnaces could be used. In these heating methods, a protective atmosphere such as a reducing or carburizing atmosphere is typically used. However, with rapid heating methods such as induction furnace heating, it may not be necessary to utilize a protective atmosphere. Another alternative heating method is disclosed in U.S. Patent No. 4,643,740. This patent describes a heating method wherein a source of electric current is connected to the article to be heated and a current sufficient to heat

the article to the required temperature is then passed there the article. While the preceding disclosure described certain preferred methods of applying the granular particle coating to the backing surface of the die, those skilled in the art may recognize other suitable methods. These are intended to be included within the scope of the present invention.

Applicant has discovered that the present invention produces a significantly higher coefficient of friction between the tubular and the die face. This higher coefficient of friction allows the present invention to firmly grasp the tubular member under substantially higher torque loads than prior art methods. For example, the die of the present invention can obtain without slippage approximately double the torque obtained in the silicon carbide screen method described above. Additionally, the present invention is easier and faster to employ and reduces the need for workers to put hands and arms in positions where there is a danger of crushing or amputation.

Figure 4 illustrates an alternate embodiment of the present invention which will be used in conjunction with a conventional bridge plug 70. Bridge plug 70 is designed to be inserted into casing or tubing such as tubular 66 and then activated in order to block the flow of fluid through tubular 66. Bridge plug 70 typically comprises a plug body 71 having an upper section 73 and a lower section 72. While not shown in detail in Figure 4, upper section 73 will be adapted in a conventional manner for attachment to a work string 90 which will allow bridge plug 70 to be lowered down the well bore and to be positioned at the desired depth of placement. Lower section 72 forms a head portion with shoulders 75 against which a rubber packing element 74 will rest. Positioned above packing element 74 is a lower expansion cone 76 and further above cone 76 is an upper expansion cone 77. Both upper and lower expansion cones 76 and 77 will have inclined surfaces 78. It will be understood that both expansion cones 76 and 77 and

packing element 74 are annular shaped and extend continuously around the plug body 71 as a single element.

Positioned between expansion cones 76 and 77 are a series of slips 60. Unlike expansion cones 76 and 77 and packing element 74, slips 60 do not form a continuous annular element around plug body 71. Rather slips 60 are a series of separate arcuate segments which are positioned around plug body 71. An opposing pair of such arcuate segments is seen in the slips 60 illustrated in Figure 5. In the bridge plug 70 of Figure 4, there are six slips 60 , but alternate embodiments could employ fewer or more slips 60. Each slip 60 will have a body.61 with inclined surfaces 62 at each end of body 61. Slip body 61 will also have an outer convex surface 68 and a slip ring channel 67. As seen in Figure 4, a slip retaining ring 63 will rest in ring channel 67 and encircle the plurality of slips 60. A slip spring 65 will be positioned between slip retaining ring 63 and ring channel 67 and will bias slips 60 away from the inner surface of tubular 66 to insure slips 60 do not unintentionally or prematurely move toward and grip the inner surface of tubular 66. Figure 4 àlso illustrates how inclined surfaces 62 of slips 60 will correspond to and travel along inclined surfaces 78 of upper and lower cones 76 and 77. Returning to Figure 5, it can be seen that slips 60 will have a granular particle coating 64 covering the outer convex surface 68 of slips 60 which will engage the inner surface 69 of tubular 66 as described below. The granular particle coating 64 is identical to granular particle coating 7 described above for dies 1 and granular particle coating 64 my be applied to slips 60 by any of the methods disclosed above.

Directly above upper cone section 77, a setting piston 80 is formed by another arcuate element which extends continuously around plug body 71. In the illustrated embodiment, setting piston 80 is integrally formed on upper cone section 77. A variable volume fluid cavity 83 is formed between setting piston 80 and plug body 71. Fluid cavity 83 will communicate with fluid

a channel 82 which runs through upper section 73 of plug body 71 and allows fluid to be transmitted from the work string, through plug body 71, to fluid cavity 83. Conventional seals such as O-rings 84 will form a fluid tight seal between setting piston 83 and plug body 71.

In operation, bridge plug 70 is positioned on a work string and lowered down the well bore to the depth at which it is desired to plug the tubing or casing. While bridge plug 70 is being lowered down the well bore, it is in the unactivated position as seen in Figure 4. After bridge plug 70 is lowered to the desired depth, it will be activated by pumping pressurized fluid through the work string into channel 82. The fluid will accumulate in variable fluid cavity 83 and begin moving setting piston 80 downward as seen in Figure 6. Setting piston 80 will in turn force upper expansion cone 77 downward causing incline surfaces 78 on upper and lower expansion cones 77 and 76 to slide along inclined surfaces 62 of slips 60. This movement will force lower expansion cone 76 against rubber packing element 74, causing it to expand against the inner surface 69 of tubular 66 and thereby sealing or pugging tubular 66. Simultaneously, the movement of inclined surfaces 78 of upper and lower expansion cones 76 and 77 along inclined surfaces 62 of slips 60 will cause slips 60 to overcome the tension in slip spring 65 and move toward and eventually engage the inner surface 69 of tubular 66. When slips 60 engage tubular 66, the granular particle surface 64 will become embedded against the inner surface 69 of tubular 66 and slips 60 will be capable of resisting the high oil or gas formation pressures that might otherwise dislodge bridge plug 70. The granular particle surface 64 provides the same advantages disclosed above in reference to dies 1 such as providing a more slip resistant gripping surface and reducing damage and scaring to tubular members.

While not illustrated in the figures, slips 60 may be used in conjunction with devices similar to bridge plugs, such as packers used for production, isolation, testing and stimulation. Packers are structurally similar to bridge plugs except that packers contain one or more internal

passages to allow a regulated flow of fluid through the packer or to accommodate instrument wires or control lines which must pass through the packer. Those skilled in the art will recognize that there are also bridge plugs and packers that are activated by means other than the hydraulic mechanism described above. Slips 60 are equally suitable for use in bridge plugs or packers which are activated by mechanical means, wirelines, electric wirelines or other conventional methods used to operate the downhole tools typically found in the drilling industry.

Nor is the scope of the present invention limited to dies 1 and slips 60 which are used in power tong or bridge plug applications. Many types of tubular handling equipment employ dies having an arcuate gripping surface and knurled steel teeth similar to the prior art power tong dies discussed above. When these tubular handling equipment dies grip CRA tubulars, the dies have the same undesirable effects such as severely marking the tubulars or inducing corrosion problems. Therefore, granular particle surface dies adapted for use in pipe handling equipment would be a significant improvement in the art and are included within the scope of the present invention.

Finally, while many parts of the present invention have been described in terms of specific embodiments, it is anticipated that still further alterations and modifications thereof will no doubt become apparent to those skilled in the art. It is therefore intended that the following claims be interpreted as covering all such alterations and modifications as fall within the true spirit and scope of the invention.

GRANULAR PARTICLE GRIPPING SURFACE

CLAIMS

I claim:

1. In an apparatus for gripping oil field tubular members, a gripping surface comprising:

a backing surface adapted to contact an oil field tubular member and attachable to the apparatus for gripping oil field tubular members; and

a friction producing coating formed on said backing surface.

2. The gripping surface according to claim 1, wherein said friction producing coating is a granular particle coating.

3. The gripping surface according to claim 2, wherein said backing surface is a die face connectable to a conventionally power tong.

4. The gripping surface according to claim 2, wherein said granulated particle coating is formed of a material sufficiently hard to penetrate the outermost surface of an oil field tubular member without said material crushing.

5. The gripping surface according to claim 2, wherein said granulated particle coating further comprises a refractory metal fused to said backing surface.

6. The gripping surface according to claim.5, wherein said refractory metal is fused to said backing surface by a metallic matrix.

7. The gripping surface according to claim 5, wherein said refractory metal is a metal carbide selected from the group consisting of the carbides of silicon, tungsten, molybdenum, chromium, tantalum, niobium, vanadium, titanium, zirconium, and boron.

8. The gripping surface according to claim 2, wherein said granulated particle coating further comprises a refractory metalloid.

9. The gripping surface according to claim 2, wherein said granulated particle coating is formed of a tungsten carbide compound.

10. A die for use in a jaw assembly, said die comprising:

a concave surface conforming to a radial curvature of an oil field tubular member to be gripped; and

a granulated particle coating formed on said concave surface.

11. The die according to claim 10, wherein said granulated particle coating is formed a material sufficiently hard to penetrate the outermost surface of a tubular member without said material crushing.

12. The die according to claim 10, wherein said granulated particle coating is formed of a refractory metal.

13. The die according to claim 10, wherein said granulated particle coating is formed from a refractory metalloid.

14. The die according to claim 10, wherein said granulated particle coating further comprises a metallic matrix fusing a refractory metal carbide to said concave surface.

15. The die according to claim 10, wherein a welding flux is used to aid in binding said granulated particle coating to said surface.

16. The die according to claim 12, wherein said refractory metal is a metal carbide selected from the group consisting of the carbides of silicon, tungsten, molybdenum, chromium, tantalum, niobium, vanadium, titanium, zirconium, and boron.

17. A die for use in a jaw assembly prepared by a process comprising the steps of:

a. preparing a surface of the die to receive a coating material;

b. applying to said surface a coating material comprising a refractory particle material;

c. heating said surface and coating material at a temperature and for a time period sufficient to allow said coating material to fuse to said surface.

18. A die for use in a jaw assembly prepared by the process of claim 17, wherein said coating material further comprises a metallic matrix and a refractory metal.

19. A die for use in a jaw assembly prepared by the process of claim 18, wherein said refractory metal is a metal carbide selected from the group consisting of the carbides of silicon, tungsten, molybdenum, chromium, tantalum, niobium, vanadium, titanium, zirconium, and boron.

20. A die for use in a jaw assembly prepared by the process of claim 18, wherein said heating step is performed while said surface and said coating material are in contact with a carburizing atmosphere.

21. A die for use in a jaw assembly prepared by the process of claim 17, wherein said surface preparing step includes applying a liquid organic binder to said surface.

22. A die for use in a jaw assembly, said die comprising:

a surface adapted to grip an oil field tubular member; and

a coating means for producing friction between said surface and an oil field tubular member, said coating means being formed on said surface.

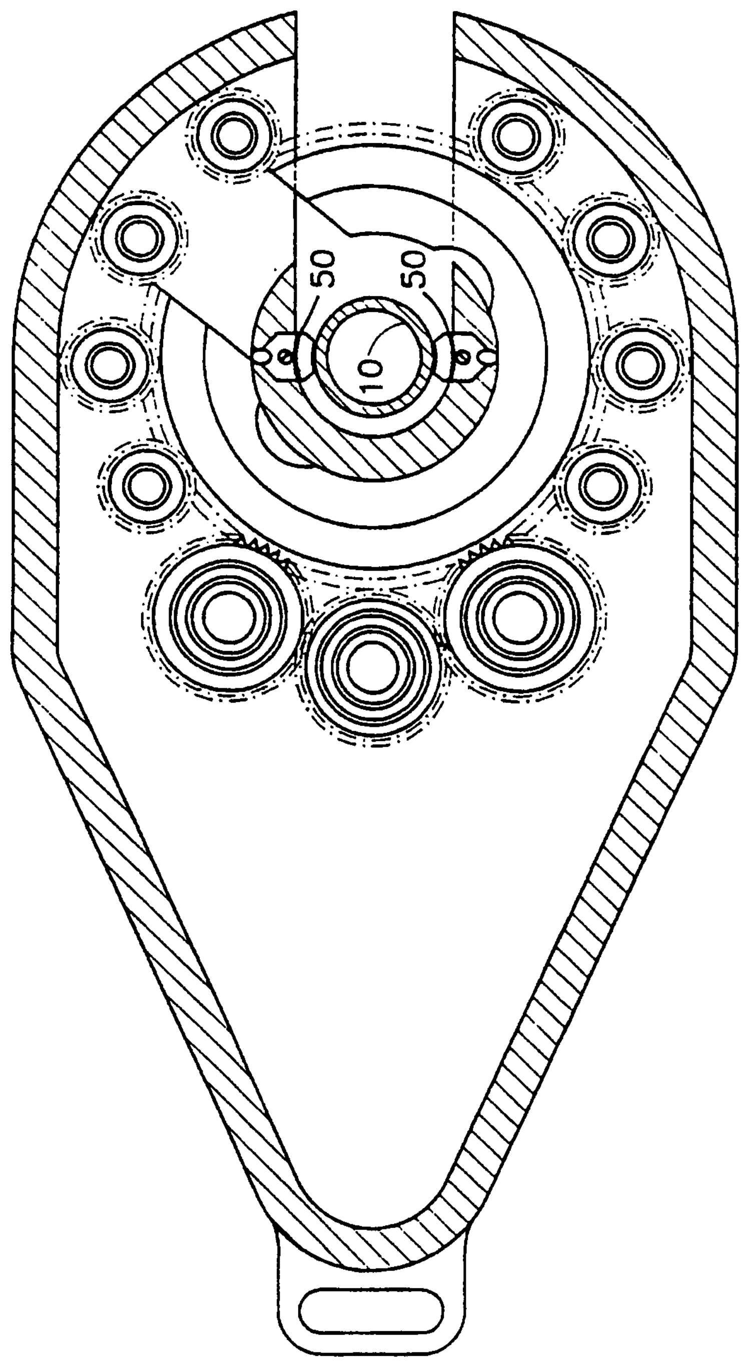
23. The die according to claim 22, wherein said coating means further comprises a granulated particle coating formed of a material sufficiently hard to penetrate the outermost surface of a tubular member without said granulated particles crushing.

24. The die according to claim 22, wherein said coating means is formed of a refractory metal.

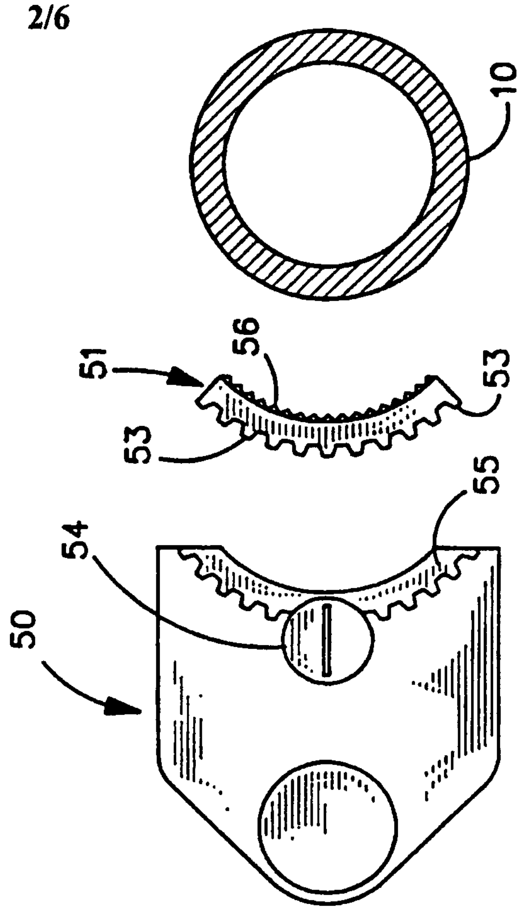
25. The die according to claim 22, wherein said coating means further comprises a metallic matrix fusing a refractory metal carbide to said surface.

26. The die according to claim 22, wherein a welding flux is used to aid in binding said coating means to said surface.

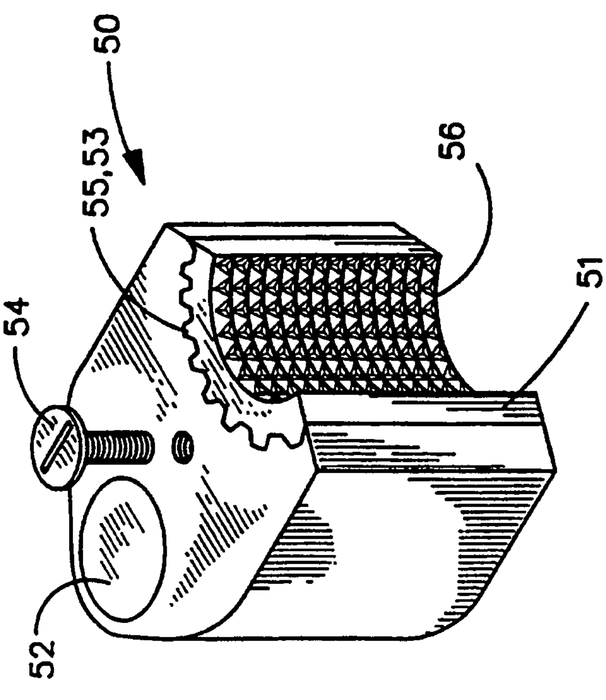
27. The die according to claim 24, wherein said refractory metal is a metal carbide selected from the group consisting of the carbides of silicon, tungsten, molybdenum, chromium, tantalum, niobium, vanadium, titanium, zirconium, and boron.



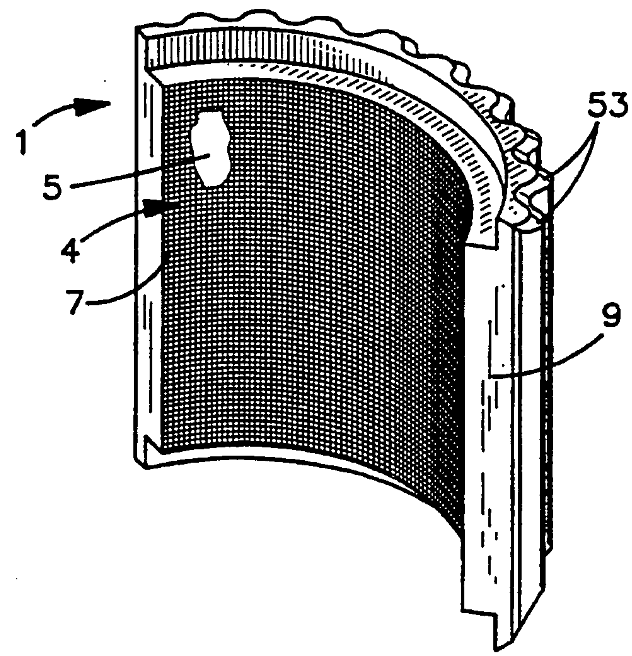
PRIOR ART
FIGURE 1



PRIOR ART
FIGURE 2b

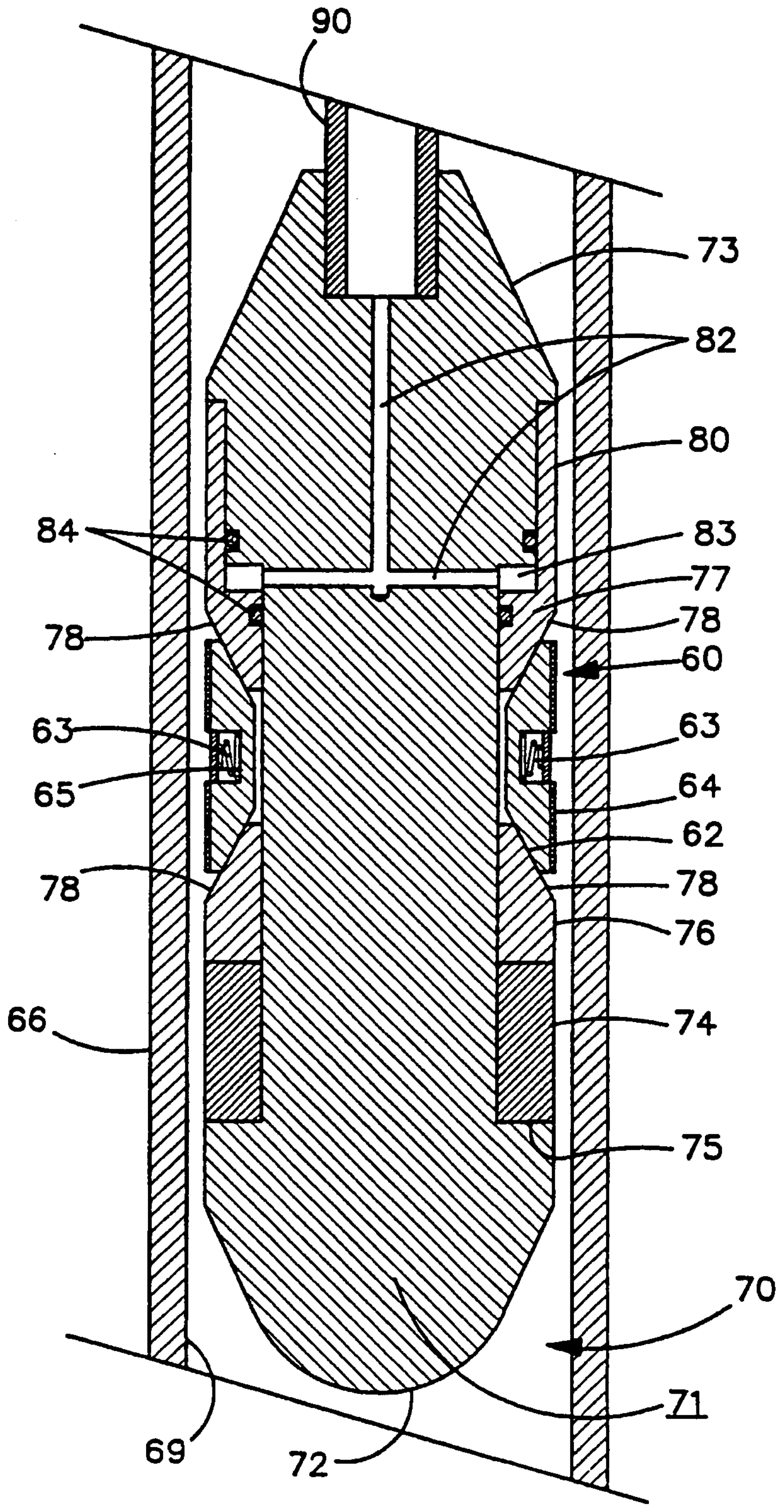


PRIOR ART
FIGURE 2a



PRIOR ART

FIGURE 3


90
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72

FIGURE 4

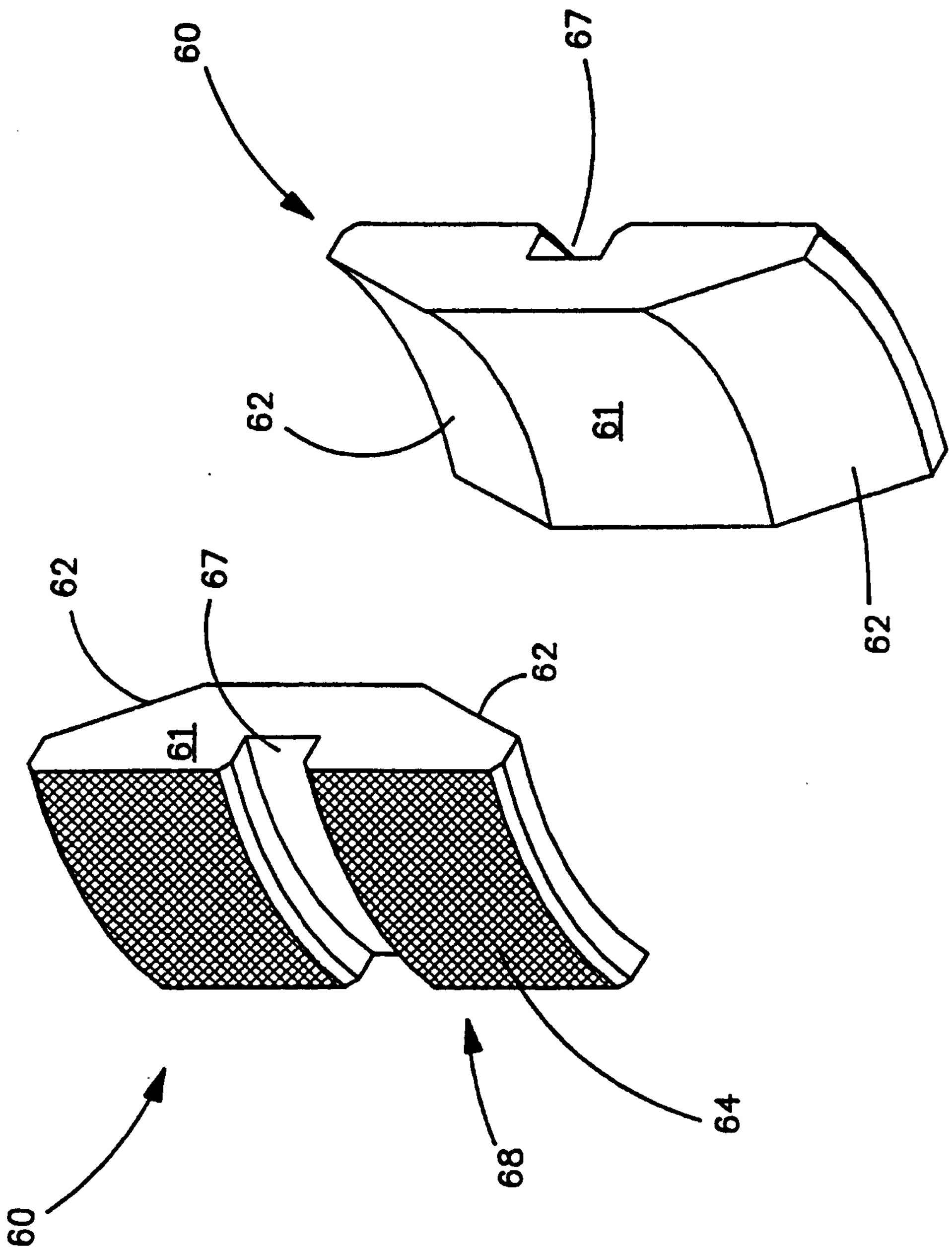

FIGURE 5

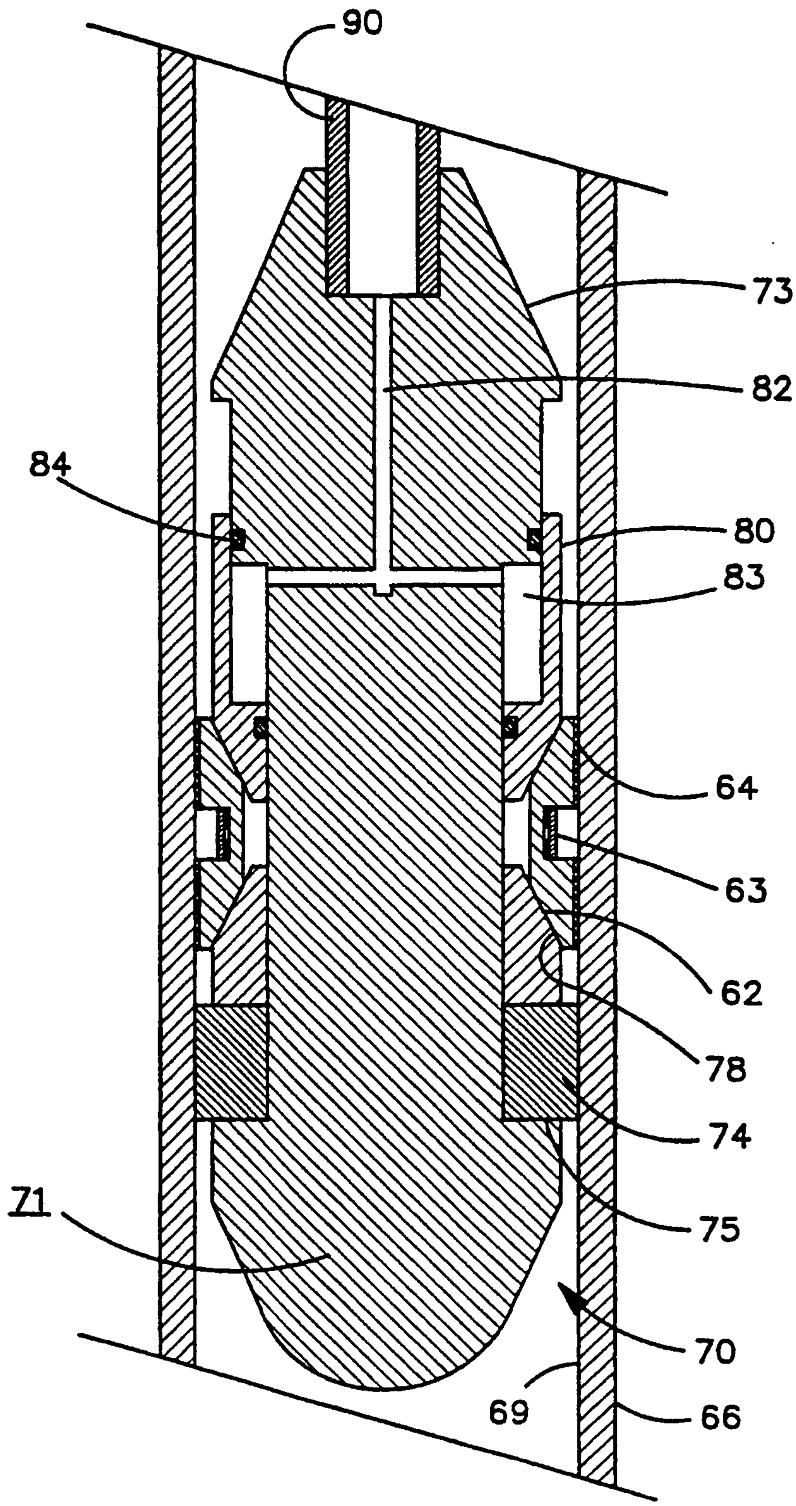

FIGURE 6